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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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1. Your reference	HL83513/000/ASG	
2. Patent application number *(The Patent Office will fill in this part)*	0225802.8	05 NOV 2002
3. Full name, address and postcode of the or of each applicant *(underline all surnames)*	DYNAMIC PROCESSING SOLUTIONS PLC Dynamic House, 8-10 Combe Road Portishead, Bristol, BS20 6BJ	
Patents ADP number *(if you know it)*		8396152001
If the applicant is a corporate body, give the country/state of its incorporation	United Kingdom	

4. Title of the invention

APPARATUS FOR TRANSFERRING SUSPENDED SOLIDS FROM AN OPEN VESSEL INTO A CLOSED VESSEL

5. Name of your agent *(if you have one)*	Haseltine Lake
"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*	Imperial House 15-19 Kingsway London WC2B 6UD
Patents ADP number *(if you know it)*	34001

	Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*
6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number			

	Number of earlier application	Date of filing *(day / month / year)*
7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application		

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:* *a) any applicant named in part 3 is not an inventor, or* *b) there is an inventor who is not named as an applicant, or* *c) any named applicant is a corporate body.* *See note (d))*	Yes

9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	-
Description	8
Claim(s)	-
Abstract	-
Drawing(s)	1

10. If you are also filing any of the following, state how many against each item.

Priority documents	-
Translations of priority documents	-
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	-
Request for preliminary examination and search *(Patents Form 9/77)*	-
Request for substantive examination *(Patents Form 10/77)*	-
Any other documents *(please specify)*	-

11. I/We request the grant of a patent on the basis of this application.

Signature Hazeltine Lake — Date 4 November 2002

12. Name and daytime telephone number of person to contact in the United Kingdom — Mr A S Giles — [0117] 910 3200

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Notes

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APPARATUS FOR TRANSFERRING SUSPENDED SOLIDS FROM AN OPEN VESSEL INTO A CLOSED VESSEL

This invention relates to apparatus for transferring suspended solids from an open vessel into a closed vessel. Particularly, although not exclusively, this invention relates to apparatus for transferring solids which have been fluidised in a fluidising unit from the open vessel into a closed vessel at a controlled rate.

BACKGROUND TO THE INVENTION

In deep see drilling operations, huge quantities of drill cuttings can accumulate around a drilling rig. A growing awareness of the environmental impact of these drill cuttings has resulted in regulations requiring their removal and treatment. However these drill cuttings tend to agglomerate and are difficult to remove quickly and efficiently. The inventors have devised a method of fluidising settled solids, in order to cause the solids to form a slurry which can be removed from the sea bed for treatment, storage or transport. In order to improve the efficiently of the process, it has been proposed that once the drill cuttings have been fluidised, they are transported to shore or into a vessel in a continuous process, so that the rate at which the drill cuttings can be removed is maximised.

In an alternative application, it may be desirable to drain a tank containing for example toxic and/or radio active waste with both liquid and solid constituents. For example it may be that that the original storage tank has corroded, or the contents are to be removed

for treatment. In this application, it is clearly important that the contents of the tank are contained at all times and that the volume of material which is transferred is minimised while still providing sufficient disturbance of the solids in the tank to ensure complete suspension of the solids and controlled emptying of the tank. Alternatively, it may be desirable to remove the solids/sludge from the bottom of the tank, without overly disturbing the fine solids, and in particular without adding to the volume of liquid in the tank, thus ensuring that the required liquid level in the tank is maintained.

STATEMENT OF INVENTION

According to the present invention there is provided apparatus for transferring suspended solids from an open vessel into a closed vessel, the apparatus comprising a suction line which extends from the closed vessel to the open vessel via a pump and a solids feed line which extends from the solids outlet in the open vessel to a solids inlet in the closed vessel, a fluidising apparatus being provided to fluidise the solids in the open vessel.

The term "open vessel" is intended to encompass any vessel open to the atmosphere or to any natural open structure which contains fluid, such as a lake bed or sea bed.

Preferably, the fluidising apparatus comprises a flow chamber having a fluid inlet and a fluid outlet, means for establishing a swirling flow in a fluid passing out of the fluid outlet, and a transport outlet for

transporting fluidised material away from the flow chamber. The transport outlet may be situated externally or internally of the flow chamber, and is preferably situated on a central axis of the flow chamber.

Preferably, means is provided for controlling the rate at which solids are transferred from the open vessel into the closed vessel. Preferably, these means comprise a flow meter which measures the rate of flow of suspended solids in the suction line or feed line.

Preferably, the closed vessel comprises a feed vessel which feeds suspended solids into a transport vessel containing a fluidising unit. Preferably, the transport vessel comprises a solids outlet through which suspended solids are discharged at a controlled rate along a slurry discharge line. Preferably, means are provided on the slurry discharge line for measuring the flow rate of slurry discharge.

Preferably, means are provided for controlling the flow rate and/or concentration of suspended solids from the open vessel into the closed vessel based on the flow rate and/or concentration of suspended solids from the transport vessel, so that the solids content of the transport vessel is maintained at a substantially constant level.

Preferably, the flow rate of suspended solids from the open vessel to the closed vessel and the rate of discharge of suspended solids from the transport vessel are controlled by means of valves. Most preferably, the valves are controlled by a computer, dependent on

input from the flow meters. Preferably, the flow meters are mass flow meters such as coriolis meters.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present invention and to show how it may be carried into effect, reference will now be made, by way of example to the accompanying drawing which is a schematic representation of a continuous feed and discharge system for transporting suspended solids.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Referring to the drawing, a tank of waste 2 containing both liquid and solid constituents is to be emptied into a slurry discharge pipeline 4 via an intermediate vessel 6 and a hydro transport vessel 8. Fluidising units 10, 12 are provided in the tank 2 and hydro transport vessel 8. Each fluidising unit 10, 12 compromises a flow chamber 14, 16 which imparts a swirling flow to fluid which is forced into the flow chamber 14, 16 under pressure, and a discharge opening 18, 20 through which suspended solids, which have been fluidised by the fluidising units 10, 12, exit the tank 2 and hydro transport vessel 8, respectively as a controlled slurry.

A suction line 22 extends from an upper part of the intermediate vessel 6, via a pump 24 into the fluid inlet of the flow chamber 14 in the tank 2. A solids feed line 26 extends from the discharge opening 18 of the fluidising unit 10 into the intermediate vessel 6 beneath an annular baffle 28. A gravity feed line 29

fitted with a valve V1 connects the bottom of the intermediate vessel 6 to the top of the hydrotransport vessel 8.

The fluidising unit 12 in the hydrotransport vessel 8 is supplied with water under pressure from a water tank 30 via a pump 32 and water supply line 34. The water supply line 34 passes through a lower end of the hydro transport vessel 8 into the flow chamber 16 of the fluidising unit 12. The discharge opening 20 of the fluidising unit 12 is connected to the slurry discharge line 4.

A first bypass line 36 extends directly from the suction line 22 into the tank 2 and is controlled by a first bypass valve V2. A second bypass line 38 extends between suction line 22 and the solids feed line 26 and is controlled by a first computer controlled valve C1. A third bypass line 40 extends between the intermediate vessel 6 in the region of the annular baffle 28, to the upper region of the hydro transport vessel 8 and is controlled by a second computer controlled valve C2. A fourth bypass line 42 extends between the upper region of the hydro transport vessel 8 and the water supply line 34 and is controlled by a third computer controlled valve C3. Finally, a fifth bypass line 44 extends from the water supply line 34 to the slurry discharge line 4 and is controlled by a fourth computer controlled valve C4.

First and second coriolis mass flow meters 46, 48 are provided in the solids feed line 26 and slurry discharge line 4 respectively. The output from the coriolis flow meters 46, 48 is input to a computer 50

which uses control algorithms to control the degree of opening of the computer controlled valves C1 to C4.

The apparatus is designed to operate continuously, so that a continuous flow of fluidised solids is discharged at a predetermined rate down the slurry discharge line 4 after which it can be treated transported or stored as appropriate. The system operates as follows.

The intermediate vessel 6 may be vented to atmosphere prior to initiation of flow (so that the intermediate vessel 6 has a cyclic flow profile). Whether or not the intermediate vessel 6 is first vented, flow is initiated by starting the pump 24, so that fluid is drawn from the intermediate vessel 6 to the tank 2 through the suction line 22. With the valves V1 and C1 fully closed, the fluid under pressure passes into the flow chamber 14 of the fluidising unit 10 and is ejected as a swirling flow, which fluidises the surrounding solids in the tank 2.

Operation of the pump 24 creates a reduction in pressure in the intermediate vessel 6 which causes the fluidised solids to be drawn into the discharge opening 18 of the solids feed line 26 and to be ejected into the intermediate vessel 6 beneath the annular baffle 28. It will be appreciated that the annular baffle 28 deflects the solids downwardly towards the bottom of the intermediate vessel 6, so that fluid withdrawn from the top of the intermediate vessel 6 into the suction line 22 is substantially free of solids.

The valve V1 which connects the intermediate vessel 6 to the hydrotrans vessel 8 is opened to allow the solids in the intermediate vessel 6 to fall under gravity into the hydrotrans vessel 8. At the same time as the pump 24 is pumping fluid around the suction line 22, the pump 32 is operating to pump water from the water tank 30 into the flow chamber 16 of the fluidising unit 12. A swirling flow of fluid is discharged from the flow chamber 16 and fluidises the solids in the bottom of the hydro transport vessel 8. The entry of water under pressure into the hydro transport vessel 8 causes a positive pressure differential which forces the fluid and fluidised solids into the discharge opening 20 of the slurry discharge line 4, so that there is a constant feed of fluidised solids along the slurry discharge line 4.

The coriolis meter 48 measures the mass flow rate in the slurry discharge line 4 and inputs this data to the computer 50. At the same time, the coriolis flow meter 46 measures the mass flow rate in the solids feed line 26 and inputs this data to the computer 50. The computer 50 is programmed to adjust the opening of the computer controlled valves C1 to C4 so as to establish a stable relationship between the mass flow rate of the fluidised solids entering the intermediate vessel with the mass flow rate of the fluidised solids passing down the slurry discharge line 4. For example, if the mass flow rate measured by the coriolis meter 46 in the solids feed line 26 is insufficient to maintain the level of solids in the intermediate vessel 6 and hence the feed of solids to the hydro transport vessel 8, the computer 50 can operate to open the computer controlled valve C4, so that the fluidising unit 12 is less

effective and the concentration of suspended solids in the flow along the slurry discharge line 4 is reduced. Alternatively, if the mass flow rate measured by the coriolis meter 46 in the solids feed line 26 is too great, such that the solids in the hydro transport vessel 8 transferred from the intermediate vessel 6 are building up faster than they are being removed down the slurry discharge line 4, the computer 50 can operate to increase the degree of opening of the computer control valve C1, so that the fluidising unit 10 is at least partially bypassed and the concentration of suspended solids in the flow in the solids feed line 26 is reduced.

In the illustrated embodiment, the suction line 22 extends from an upper part of the intermediate vessel 6. In an alternative embodiment, the suction line 22 extends from the base of the intermediate vessel 6, drawing through a lateral collection system which is positioned within a filter media bed (not shown) below the fluidising unit 12. This arrangement could be used in a batch system or single vessel system, rather than a continuous feed system, and would be particularly effective in capturing fine slow settling solids into the slurry. In a batch system, the hydrotransport vessel 8, discharge line 4 and associated mass flow meter could be dispensed with and the solids discharged from the intermediate vessel 6 in batches. The batch discharge of solids could be controlled by the computer 50 on the basis of input from the mass flow meter 46 alone. However, other control input, such as a measurement of level of settled solids in the intermediate vessel 6 could be used to trigger batch discharge.

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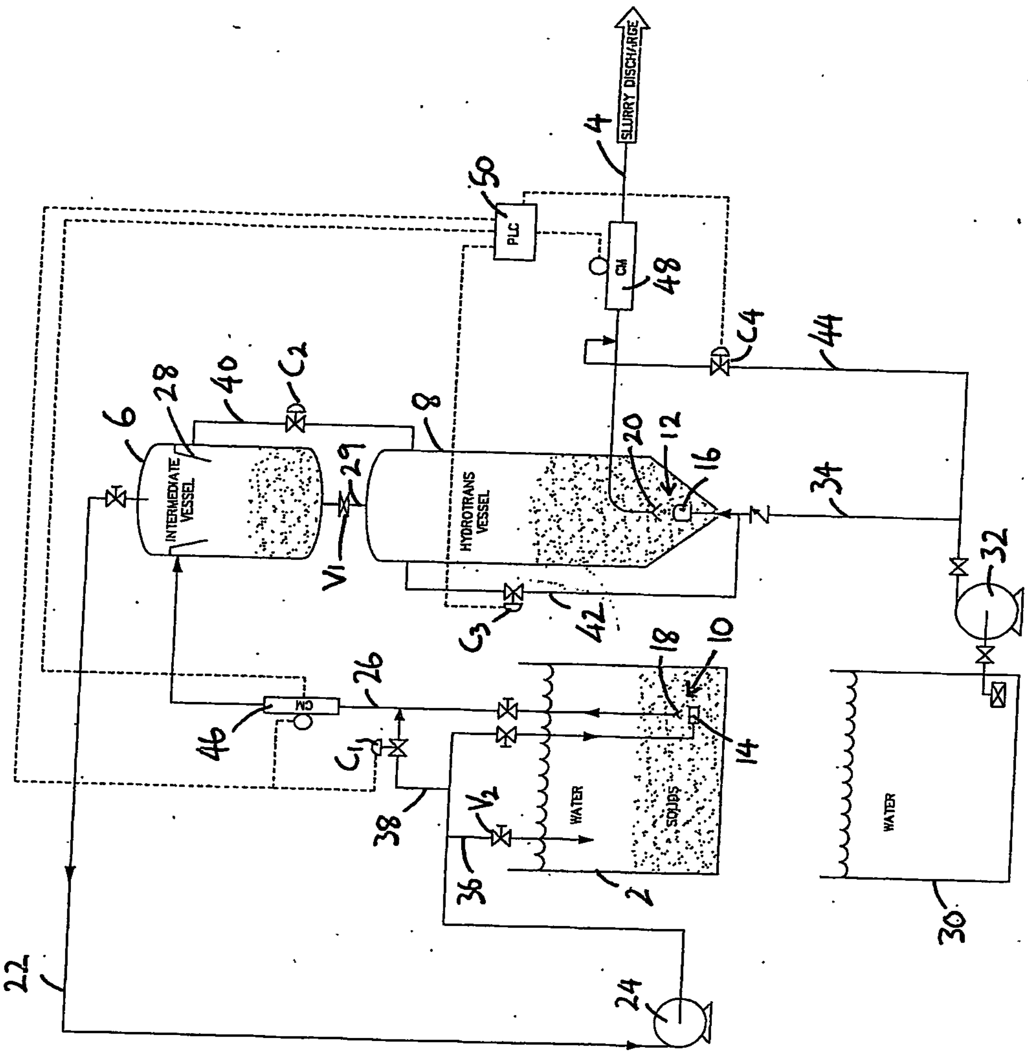
SLURRY DISCHARGE
PLC
CM
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INTERMEDIATE VESSEL
HYDROTRANS VESSEL
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V1
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PCT Application

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